

5.14.1.2.7 SIMPLE SPAN PRESTRESSED GIRDERS MADE CONTINUOUS

Negative Moments

The following design criteria shall apply for the design of the negative moment steel in the deck.

Case 1 Girders Designed As Simple Spans & Reinforcement Added To Control Cracking.

(This is the typical design case for new bridges)

- The top longitudinal deck reinforcement over the piers, in addition to the standard empirical design reinforcement, shall be #6 bars at 12" spaced between the standard top deck bars. The full area of the additional reinforcement shall extend either direction from the bearing centerlines a distance of at least 10 feet or 15% of the longer span whichever is greater. At least half the area of the additional reinforcement shall extend to a distance from the pier of at least 15 ft or 20% of the longer span whichever is greater.
- The bottom longitudinal deck reinforcement shall be per the empirical design method, Article 9.7.2.

Case 2 Girders Designed Fully Continuous For Live Load

(This case may be used for new bridges where Case 1 is not feasible)

- The weight of the parapet may be distributed evenly to all the girders.
- The maximum negative moment may be taken at the face of the support.
- Longitudinal reinforcement shall be anchored in accordance with Article 5.14.1.2.7b.
- The section shall meet Strength 1 limit state requirements as follows:
 - $1.25 \cdot DC_{\text{noncomposite}}$, acting as simply supported and
 - $1.25 \cdot DC_{\text{composite}} + 1.5 \cdot DW + 1.75 \cdot LL$, acting as a continuous beam.
- Both layers of steel in the deck may be used in resisting the negative moments.
- Only structures with fully effective construction joints at the piers, per Article 5.14.1.2.7c, shall be designed as continuous for the Service III limit state. This may be accomplished by placing the pier diaphragm concrete and the negative moment regions of the deck first and the positive moment regions only after the pier diaphragm concrete has reached 100% of its design strength.

Case 3 Girders Designed As Simple Spans And The Deck Is Replaced To Eliminate Joints.

(This case is used for existing bridges that are retrofitted)

- No design is required. Use #5 bars in the top mat at approximately 12" spacing over the piers and carry them at least a development length past the face of the support but not beyond the 1/4 pt.

Commentary

Case 1 – The additional reinforcement is based on providing enough steel in the deck over the piers to limit the top deck steel stress to 36 ksi, the maximum allowed for serviceability. This is based on the assumption that all girders act together as a single unit, as in deflection calculations, and that the distance between the centerlines of bearings for each of the spans on a bent is at least 24 inches. The 24 inches between bearings is assumed to act as a short span between the main spans with a moment of inertia of a cracked section. The additional deck steel along with the steel provided in the empirical design method may not supply enough negative moment capacity to resist the full negative moments that would be realized in continuous girder design, however it will provide enough restraint to limit the steel stress to 36 ksi under service loads for all prestressed girder depths up to 72".

Case 2 – If the negative moment areas of the deck are placed first it may be assumed that the provisions of Article 5.14.1.2.7c are met. However, the deck reinforcement over the piers will then need to be designed for the negative moments at the piers generated by the concrete placed in the positive moment areas of the spans in addition to the composite loads. Otherwise the calculations of Article 5.14.1.2.7c will need to be provided in order to utilize continuity for Service III.